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TITLE: SUBSTRATE HAVING TRANSPARENT
CONDUCTIVE FILM AND SOLAR
CELLS

PUBN-DATE: October 29, 1999

INVENTOR-INFORMATION:

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INT-CL (IPC): H01L031/04

ABSTRACT:

PROBLEM TO BE SOLVED: To provide a substrate having a transparent conductive film, in which cost is reduced and intensity is improved by forming a transparent conductive film of a tin oxide, having a major orientation crystal plane of (211) plane or (301) plane, and solar cells thereof.

SOLUTION: A transparent conductive film 2 is formed on a substrate 1 with a tin oxide having major orientation crystal plane of either a (211) plane or a (301) plane. A photoelectric layer 3 is formed with the transparent conductive film 2 side by stacking three semiconductor layers of p, i and n types of an amorphous semiconductor, and furthermore a metal electrode 4 having a metal such as Ag, Al or so on is formed on a backside electrode to form a

photoelectric conversion device 10. Furthermore, power extracting lines 7 and 8 are formed, and backside safeguard members consisting of aluminum-foiled sandwich-type vinyl fluoride film and so on are placed. A photoelectric layer 3 of amorphous semiconductor is placed on the transparent conductive film 2 to increase intensity.

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TITLE: Transparent substrate used for
amorphous solar battery -
has transparent electrically
conductive film with
predetermined thickness, and tin
oxide formed on its main
surface

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ABSTRACTED-PUB-NO: JP 11298018A

BASIC-ABSTRACT:

NOVELTY - The transparent electrically conductive film (2)
which consists of
tin oxide formed on the main surface of a substrate (1).
The film thickness of
the conductive film is 6000 Angstrom or less.

USE - Used in amorphous solar battery.

ADVANTAGE - Offers sufficient strength to solar battery by
forming transparent
electrically conductive film containing tin oxide on the
substrate surface.

Since tempered glass is not used, cost of solar battery is reduced.

DESCRIPTION OF DRAWING(S) - The figure shows the sectional view of solar battery. (1) Substrate; (2) Electrically conductive film.

(19)日本国特許庁 (J P)

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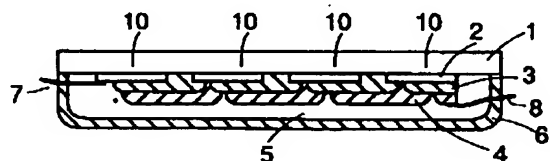
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(54)【発明の名称】 透光性導電膜付き基板及び太陽電池

(57)【要約】

【目的】 低コストで且つ強度の高い太陽電池を提供することを目的とする。

【構成】 (211)面或いは(301)面のいずれかを主要面方位とする酸化錫からなる透光性導電膜を備えた透光性導電膜付き基板を用いて太陽電池とする。



1:基板 2:透光性導電膜 3:光電変換層
4:裏面電極 5:封止材 6:裏面保護部材
7、8:取り出し線 10:光電変換素子

【特許請求の範囲】

【請求項1】 (211)面もしくは(301)面のいずれかを主要面方位とする酸化錫からなる透光性導電膜を表面に備えることを特徴とする透光性導電膜付き基板。

【請求項2】 上記透光性導電膜の膜厚が約6000Å以下であることを特徴とする請求項1記載の透光性導電膜付き基板。

【請求項3】 基板上に、透光性導電膜、光電変換層及び裏面電極を備えてなる太陽電池であって、前記透光性導電膜が、(211)面或いは(301)面のいずれかを主要面方位とする酸化錫からなることを特徴とする太陽電池。

【請求項4】 前記透光性導電膜、光電変換層及び裏面電極が前記基板上に於いて複数個に分割されており、且つ透光性導電膜、光電変換層及び裏面電極からなる複数個の光電変換素子が前記基板上で電氣的に直列接続されてなることを特徴とする請求項3記載の太陽電池。

【請求項5】 前記裏面電極上に絶縁性封止材を介して裏面部材を備えたことを特徴とする請求項4記載の太陽電池。

【請求項6】 前記透光性導電膜の膜厚が約6000Å以下であることを特徴とする請求項3乃至5のいずれかに記載の太陽電池。

【発明の詳細な説明】

【0001】

【発明の属する技術分野】本発明は、低コストで且つ強度の優れた大面積の非晶質太陽電池を提供する技術である。

【0002】

【従来の技術】非晶質シリコンを代表とする非晶質半導体を用いた非晶質太陽電池は、単結晶シリコンなどの結晶系半導体を用いた結晶系太陽電池と比較してその製造温度が低温であることから低コスト用の太陽電池として検討されている。

【0003】図4は従来の非晶質太陽電池の構造を示す素子構造断面図である。

【0004】同図において、101はガラス、プラスチック等からなる透光性の基板、102は酸化錫或いは酸化インジウム錫等の透光性導電材からなる透光性導電膜である。また、103はp型の非晶質SiCからなる厚さ100Å程度のp層、104はi型の非晶質Siからなる厚さ3000～6000Å程度のi層、105はn型の非晶質Siからなる厚さ200Å程度のn層であり、これらp層103、i層104及びn層105から光電変換層が構成される。そして、上記n層105上にはAg、Al等の金属からなる裏面電極106が形成されている。

【0005】そして、斯かる構成の太陽電池に基板101側から入射した光は上記i層104内で吸収されると

共に該i層104内で電子・正孔対を生成し、そしてこれら電子及び正孔が夫々裏面電極106及び透光性導電膜102から取り出されることにより起電力を生じる。

【0006】

【発明が解決しようとする課題】ところで、上記従来の非晶質太陽電池を用いた電力用の大面積の太陽電池に於いては、屋外に設置されることから強度面での補強が必要となる。このため従来は強化ガラス或いは合せガラスを非晶質太陽電池の光入射側に設けた、所謂スーパーストレート方式としていた。

【0007】図5は斯かる従来のスーパーストレート方式の太陽電池の断面図であり、銅箔110により電氣的に接続された複数個の単位太陽電池100が、白板強化ガラス120とアルミニウム箔サンドイッチ型フッ化ビニルフィルムなどの裏面保護部材130との間にEVA等の透光性を有する絶縁性封止材140により封止されている。

【0008】然し乍ら、斯かる従来の太陽電池においては、本来低コスト化に有利な非晶質半導体を用いているにも係らず、強度上の要請から強化ガラスや合わせガラスにより補強しなければならず、製造コストが増大するという課題があった。

【0009】また、斯かるスーパーストレート方式に代わる太陽電池として、基板に強化ガラスを用い、この強化ガラス上に直接非晶質半導体を形成した太陽電池も検討されている(例えば、特開平6-310748号公報)。

【0010】然し乍ら、斯かる方法においても基板として高価な強化ガラスを使用するために、コストが増大するという課題があった。

【0011】本発明は、斯かる課題に鑑みなされたもので、低コストで且つ強度の高い太陽電池を提供することを目的とする。

【0012】

【課題を解決するための手段】上記課題を解決するために、本発明透光性導電膜付き基板は(211)面もしくは(301)面のいずれかを主要面方位とする酸化錫からなる透光性導電膜を表面に備えることを特徴とし、また前記透光性導電膜の膜厚が約6000Å以下であることを特徴とする。

【0013】また、本発明太陽電池は基板上に、透光性導電膜、光電変換層及び裏面電極を備えてなる太陽電池であって、前記透光性導電膜が、(211)面或いは(301)面のいずれかを主要面方位とする酸化錫からなることを特徴とし、また前記透光性導電膜、光電変換層及び裏面電極が前記基板上に於いて複数個に分割されており、且つ透光性導電膜、光電変換層及び裏面電極からなる複数個の光電変換素子が前記基板上で電氣的に直列接続されてなることを特徴とする。

【0014】さらに、本発明太陽電池は前記裏面電極上

に絶縁性封止材を介して裏面部材を備えたことを特徴とし、さらには前記透光性導電膜の膜厚が約6000Å以下であることを特徴とする。

【0015】

【発明の実施の形態】図1は本発明太陽電池の断面図であり、1は白板ガラス、或いは青板ガラス等からなり、熱風冷強化処理、化学的強化処理等の強化処理を行っていない通常の基板である。また、ガラス成分が溶出しないよう、必要に応じて基板表面に酸化珪素膜などを被着したものをを用いても良い。

【0016】また、2は前記基板1上に分割配置された複数の透光性導電膜であり、本発明においてはこの透光性導電膜2が、(211)面もしくは(301)面のいずれかを主要面方位とする酸化錫から構成されている。

【0017】さらに、3は前記透光性導電膜2側から非晶質半導体からなるp、i、n型の各半導体層が積層されてなる光電変換層であり、4はAg、Al等の金属からなる裏面電極である。そして、前記透光性導電膜2、光電変換層3及び裏面電極4からなる複数の光電変換素子10は、相隣接する光電変換素子間において一方の素子の裏面電極が他方の素子の透光性導電膜上にまで延在することにより電気的に直列接続され、所謂集積型の太陽電池とされている。

【0018】そして、上記の光電変換素子10の裏面側はEVA等の絶縁性封止材5を介してアルミニウム箔サンドイッチ型フッ化ビニルフィルムなどからなる裏面保護部材6で封止されている。尚、7及び8は電力取り出し用の取り出し線である。

【0019】斯かる本発明の太陽電池によれば、(211)もしくは(301)面のいずれかを主要面方位とする酸化錫からなる透光性導電膜が形成された透光性導電膜付き基板を用いたので、従来のように強化ガラスを用いずとも強度の高い低コストの電力用太陽電池を提供できる。

(実施例)次に、本発明の実施例について説明する。

【0020】まず、表面として厚さ1000Åの酸化珪素を形成した厚さ3mm、寸法350mm×450mmの未強化のガラスを用意し、酸化珪素上に常圧熱CVD*

*法により厚さ約6000Åの酸化錫膜を形成した。酸化錫膜の形成条件は、原料ガスがSnCl₄:2mol%、H₂O:10mol%、O₂:1mol%、CF₃CH₂F:1mol%であり、基板温度を450、500、550、600℃と変化させて形成している。

【0021】尚、このような形成条件では酸化錫膜の表面に高低差が数1000Å程度の凹凸が形成されるが、ここでは凹凸の底の部分と基板表面との間の距離を膜厚としている。

10 【0022】図2に以上のようにして形成した酸化錫膜の面方位をX線回折による測定した測定結果を示す。尚、同図(A)は基板温度が450℃の場合、(B)は500℃の場合、(C)は550℃の場合、そして(D)は600℃の場合を夫々示している。

【0023】図1から明らかに、基板温度が450℃(同図(A))及び500℃(同図(B))の場合には(110)或いは(200)面が最もピーク強度の大きい主要面方位となっているのに対し、基板温度が550℃(同図(C))及び600℃(同図(D))の場合には(211)或いは(301)面が主要面方位となっている。

【0024】尚、本発明において主要面方位とは、ここで述べたようにX線回折による測定結果において、最も大きいピーク強度を示す面方位を示している。

【0025】次いで、これらの4種類の酸化錫膜の形成されたガラス基板を夫々10枚ずつ用意し、降雪試験の簡易試験方法により強度を調べた。この結果を表1に示す。

【0026】尚、この試験方法はJIS R 3212に規定の方法であって、具体的にはガラス面を上向きとして水平に固定し、そしてこのガラスの中心に、質量22.7±2g、直径約3.8mmの表面が滑らかな鋼球を1mの高さから力を加えずに落下させて強度を調べる方法である。そして、この試験によりガラスの破損がなかったものの割合を歩留として表1に示している。

【0027】

【表1】

主要面方位		(110)	(200)	(211)	(301)
歩留	A ⁺ ターニング前	30%	100%	100%	100%
	A ⁺ ターニング後	0%	30%	100%	100%

【0028】同表から明らかに、(200)面、(211)面或いは(301)面のいずれかを主要面方位とする酸化錫膜を備えた基板が高い強度を有することがわかる。

【0029】ところで、このように酸化錫膜の形成されたガラスを基板として太陽電池とするにあたっては、非晶質半導体からなる光電変換層形成前に前もってレーザ※50

※パターニング法を用いて酸化錫膜の所定部を除去し、酸化錫膜を各太陽電池素子毎に分離する必要がある。そして、このレーザパターニングにより基板の強度が変化する可能性があるため、レーザパターニング後の基板についても強度を上記と同様の方法により調べた。この結果も表1に合わせて示す。

【0030】尚、レーザパターニングの条件としては通

常の集積型の太陽電池を製造するときの条件と同一とし、波長1.06 μ mのYAGレーザを用いて約1cm間隔で幅約150 μ mの領域をライン状に除去している。

【0031】表1から明らかに、このようにレーザパターニングを行った後においては基板温度500℃で形成された酸化錫膜、即ち主要面方位が(200)面となる酸化錫膜の形成された基板において強度が劣化している。これに対し、基板温度が550℃及び600℃で形成された、即ち主要面方位が(211)面或いは(301)面である酸化錫膜の形成された基板ではレーザパターニング後においても歩留が100%であり、十分な強度を有している。

【0032】従って、斯かる(211)面或いは(301)面が主要面方位である酸化錫膜なる透光性導電膜*

膜厚(A)	5000	6000	7000	8000
歩留	100%	100%	50%	30%

【0036】表2から明らかに、酸化錫膜の膜厚を6000Å以下とすることで十分な強度を有することができる。この理由は、膜厚が厚くなるほどレーザパターニングに要する時間が長くなりガラスが受ける熱影響が大きくなることに起因するものと推測される。

【0037】尚、酸化錫膜の膜厚が6000Å以下の場合にはレーザパターニングに要する時間が短くなるため、強度が低下することはないものと考えられるが、実用上2000Å以下となると抵抗成分が増大し、太陽電池としたときに光起電力特性が低下するため、酸化錫膜の膜厚は2000Å以上が好ましい。

【0038】また、主要面方位が(110)面或いは(200)面のいずれかである酸化錫膜を透光性導電膜として備えた基板を用いて同様の試験を行った結果、これらの場合には膜厚を実用的な下限である2000Åまで薄くしても、歩留は改善されなかった。

【0039】次に、本発明太陽電池の製造工程について説明する。

【0040】図3は本発明太陽電池に用いる太陽電池の製造工程を説明するための工程別断面図であり、図1と同一の部分には同一の符号を付してある。

【0041】まず、図3(A)の工程では、厚さ3mm、寸法350mm×450mmの白板ガラスの表面に厚さ1000Åの酸化珪素を形成したものを基板1として用い、この基板1上に常圧熱CVD法により厚さ約6000Åの酸化錫膜2'を形成する。この時、形成条件を、原料ガスがSnCl₄:2mol%, H₂O:10mol%, O₂:1mol%, CF₃CH₂F:1mol%とし、基板温度を550℃とすることにより主要面方位が(211)面である酸化錫膜を形成した。

【0042】次に、同図(B)の工程では、波長1.06 μ mのYAGレーザを用いて上記酸化錫膜2'をパタ※50

*が形成された基板を用い、この透光性導電膜上に非晶質半導体からなる光電変換層を形成することで、十分強度の高い太陽電池を提供することができる。

【0033】尚、上述のようにレーザパターニングにより強度が低下する理由については、面方位の相違によりレーザ照射によって酸化錫膜の受ける熱的影響が変化することに起因するものと推測される。

【0034】次に、(211)面を主要面方位とする酸化錫膜が形成された白板ガラスにおいて、酸化錫膜の膜厚を夫々5000Å、6000Å、7000Å及び8000Åと変化させたときの強度を前記と同様にして比較した結果を表2に示す。尚試験は、レーザパターニング後のものについて行っている。

【0035】

【表2】

※ーニングし、各太陽電池素子毎の透光性導電膜2を形成した。尚、この時各太陽電池素子毎の透光性導電膜2の幅が夫々約1cm程度となるようパターニングすると共に、各透光性導電膜2間の間隔を約150 μ mとすることで、隣接する透光性導電膜2、2間の抵抗値を1M Ω 以上としている。

【0043】次いで、同図(C)の工程では、透光性導電膜2上に、基板温度200℃、反応圧力0.5~1.0Torrにてモノシラン、メタン、ジボランからなる混合ガス、モノシラン、水素からなる混合ガス、モノシラン、ホスフィン、水素からなる混合ガスをこの順に容量結合型グロー放電分解装置内で分解することにより、膜厚100Å程度のp型非晶質SiC層、膜厚4000Å程度のi型非晶質シリコン層、及び膜厚200Å程度のn型非晶質シリコン層を順次積層した。

【0044】そして、このp-i-nの非晶質半導体層の積層体を、透光性導電膜2の分離部より約50 μ mずらして、波長0.53 μ mのYAGレーザの第2高調波を用いて分離し、各太陽電池素子毎の光電変換層3とした。

【0045】その後、同図(D)に示す工程では、抵抗加熱蒸着法を用いて厚さ250nm程度のAl層を形成し、上記光電変換層3の分離部分よりさらに50 μ m程度ずらして波長0.53 μ mのYAGレーザの第2高調波により分離し、各太陽電池素子の裏面電極4とした。

【0046】以上の工程により、集積型の非晶質太陽電池が製造される。尚、上記のレーザスクライプ幅は、透光性導電膜、光電変換層、裏面電極で夫々約150、150、150 μ mとした。

【0047】そして、このようにして形成された集積型の太陽電池の裏面電極側に、EVA等の絶縁性封止材及びアルミニウム箔サンドイッチ型フッ化ビニルフィルム

などからなる裏面保護部材を積層し、真空ラミネート法を用いて図1の構造の太陽電池を製造した。

【0048】この結果、斯かる構成の太陽電池においても、基板として主要面方位が(211)面である酸化錫からなる透光性導電膜が形成された透光性導電膜付き基板を用いたので、十分な強度を有する太陽電池を提供でき、従来のように強化ガラスを用いることなく低コストで強度の高い太陽電池を提供できる。

【0049】また、この例では主要面方位が(211)面である酸化錫を用いたが、主要面方位が(301)面である酸化錫膜を用いても同様の効果が得られる。

【0050】

【発明の効果】以上説明した如く、本発明による主要面方位が(211)面或いは(301)面である酸化錫からなる透光性導電膜を備えた透光性導電膜付き基板によれば、強度の高い太陽電池用基板を提供でき、さらにこの基板を用いることにより、従来のように強化ガラスを用

いることなく、低コストで十分な強度を有する太陽電池を提供できる。

【図面の簡単な説明】

【図1】本発明太陽電池の断面図である。

【図2】酸化錫膜のX線回折による測定結果である。

【図3】本発明の太陽電池の製造工程を説明するための工程別構造断面図である。

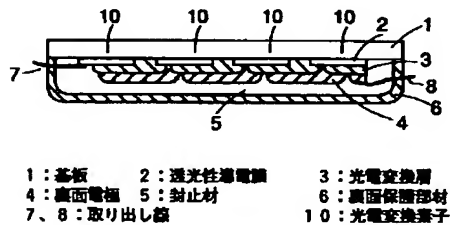
【図4】従来の非晶質太陽電池の素子構造断面図である。

【図5】スーパーストレート方式の太陽電池の断面図である。

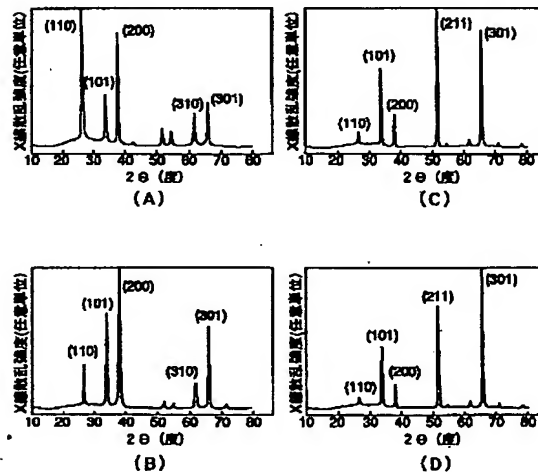
【符号の説明】

1…基板、2…透光性導電膜、3…光電変換層、4…裏面電極、5…封止材、6…裏面保護部材、10…光電変換素子、100…単位太陽電池、110…銅箔、120…強化ガラス、130…裏面保護部材、140…封止材

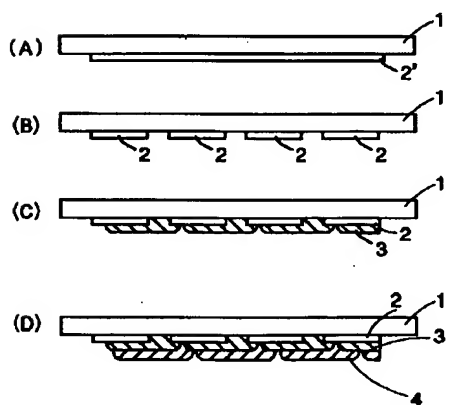
【図1】



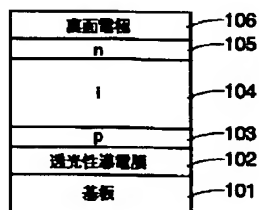
【図2】



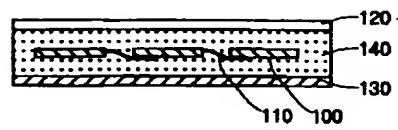
【図3】



【図4】



【図5】



100: 単位太陽電池 110: 銅箔 120: 強化ガラス
130: 表面保護部材 140: 絶縁性封止材

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CLAIMS

[Claim(s)]

[Claim 1] (211) The substrate with the translucency electric conduction film characterized by equipping a front face with the translucency electric conduction film which consists of tin oxide which makes either a field or (301) a field principal plane bearing.

[Claim 2] The substrate with the translucency electric conduction film according to claim 1 characterized by the thickness of the above-mentioned translucency electric conduction film being about 6000A or less.

[Claim 3] The solar battery which is a solar battery which comes to have the translucency electric conduction film, a photo-electric-conversion layer, and a rear-face electrode on a substrate, and is characterized by said translucency electric conduction film consisting of tin oxide which makes either a field (211) or (301) a field principal plane bearing.

[Claim 4] The solar battery according to claim 3 characterized by coming electrically to carry out series connection of two or more optoelectric transducers which said translucency electric conduction film, the photo-electric-conversion layer, and the rear-face electrode are divided on said substrate at plurality, and consist of the translucency electric conduction film, a photo-electric-conversion layer, and a rear-face electrode on said substrate.

[Claim 5] The solar battery according to claim 4 characterized by having flesh-side surface part material through an insulating sealing agent on said rear-face electrode.

[Claim 6] The solar battery according to claim 3 to 5 characterized by the thickness of said translucency electric conduction film being about 6000A or less.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Field of the Invention] This invention is the technique of offering the amorphous solar battery of the large area which is low cost and was excellent in reinforcement.

[0002]

[Description of the Prior Art] Since the manufacture temperature is low temperature as compared with the crystal system solar battery which used crystal system semi-conductors, such as single crystal silicon, the amorphous solar battery using the amorphous semiconductor which makes amorphous silicon representation is examined as a solar battery for low cost.

[0003] Drawing 4 is the component structure section Fig. showing the structure of the conventional amorphous solar battery.

[0004] In this drawing, the substrate of translucency with which 101 consists of glass, plastics, etc., and 102 are translucency electric conduction film which consists of translucency electric conduction material, such as tin oxide or indium oxide tin. Moreover, p layers with a thickness of about 100A which 103 becomes from the amorphous substance SiC of p mold, i layers with a thickness of about 3000-6000A which 104 becomes from amorphous Si of i mold, and 105 are n layers with a thickness of about 200A it is thin from amorphous Si of n mold, and these p layers 103 or i layers of photo-electric-conversion layers consist of 104 and n layer 105. And on the above-mentioned n layer 105, the rear-face electrode 106 which consists of metals, such as Ag and aluminum, is formed.

[0005] And the light which carried out incidence to the solar battery of this configuration from the substrate 101 side generates an electron and an electron hole pair within this i layer 104 while being absorbed within the above-mentioned i layer 104, and it produces electromotive force by taking out these electrons and an electron hole from the rear-face electrode 106 and the translucency electric conduction film 102, respectively.

[0006]

[Problem(s) to be Solved by the Invention] By the way, in the solar battery of the large area for power using the above-mentioned conventional amorphous solar battery, since it is installed in the outdoors, the reinforcement in respect of reinforcement is needed. For this reason, it was considering as the so-called super straight method by which tempered glass or laminated glass was formed in the optical incidence side of an amorphous solar battery conventionally.

[0007] Drawing 5 is the sectional view of the solar battery of this conventional super straight method, and the closure of two or more unit solar batteries 100 electrically connected by copper foil 110 is carried out with the insulating sealing agent 140 which has translucency, such as EVA, between white sheet tempered glass 120 and the rear-face protection members 130, such as an aluminium foil sandwiches mold fluoride [vinyl] film.

[0008] however, in ** et al. and this conventional solar battery, an amorphous semiconductor advantageous to low-cost-izing originally is used -- **** -- it did not have to start, but had to reinforce with tempered glass or a glass laminate from the request on reinforcement, and the technical problem that a manufacturing cost increased occurred.

[0009] Moreover, as a solar battery which replaces this super straight method, tempered glass is used for a substrate and the solar battery in which the direct amorphous semiconductor was formed on this tempered glass is also examined (for example, JP,6-310748,A).

[0010] However, in order to use tempered glass expensive as a substrate also in ** et al. and this approach, the technical problem that cost increased occurred.

[0011] This invention was made in view of this technical problem, and it is low cost and it aims at offering a solar battery with high reinforcement.

[0012]

[Means for Solving the Problem] In order to solve the above-mentioned technical problem, it is characterized by the substrate with this invention translucency electric conduction film equipping a front face with the translucency electric conduction film which consists of tin oxide which makes either a field (211) or (301) a field principal plane bearing, and is characterized by the thickness of said translucency electric conduction film being about 6000Å or less.

[0013] Moreover, this invention solar battery is a solar battery which comes to have the translucency electric conduction film, a photo-electric-conversion layer, and a rear-face electrode on a substrate. It is characterized by said translucency electric conduction film consisting of tin oxide which makes either a field (211) or (301) a field principal plane bearing. moreover, the thing for which it comes electrically to carry out series connection of two or more optoelectric transducers which said translucency electric conduction film, the photo-electric-conversion layer, and the rear-face electrode are divided on said substrate at plurality, and consist of the translucency electric conduction film, a photo-electric-conversion layer, and a rear-face electrode on said substrate -- the description -- smoothly .

[0014] Furthermore, it is characterized by equipping this invention solar battery with flesh-side surface part material through an insulating sealing agent on said rear-face electrode, and is characterized by the thickness of said translucency electric conduction film being about 6000Å or less further.

[0015]

[Embodiment of the Invention] Drawing 1 is the sectional view of this invention solar battery, and 1 is the usual substrate which consists of white sheet glass or blue plate glass, and omits strengthening processing of hot blast cold strengthening processing, chemical strengthening processing, etc. Moreover, what put the oxidation silicon film etc. on the substrate front face if needed may be used so that a glass component may not be eluted.

[0016] Moreover, 2 is two or more translucency electric conduction film by which division arrangement was carried out on said substrate 1, and consists of tin oxide to which this translucency electric conduction film 2 makes either a field (211) or (301) a field principal plane bearing in this invention.

[0017] Furthermore, 3 is a photo-electric-conversion layer to which it comes to carry out the laminating of p and i which consist of an amorphous semiconductor, and each semi-conductor layer of n mold from said translucency electric conduction film 2 side, and 4 is a rear-face electrode which consists of metals, such as Ag and aluminum. And when the rear-face electrode of one component extends even on the translucency electric conduction film of the component of another side between the optoelectric transducers which adjoin each other, series connection of two or more optoelectric transducers 10 which consist of said translucency electric conduction film 2, a photo-electric-conversion layer 3, and a rear-face electrode 4 is carried out electrically, and let them be the so-called accumulation type of solar batteries.

[0018] And the closure of the rear-face side of the above-mentioned optoelectric transducer 10 is carried out by the rear-face protection member 6 which consists of an aluminium foil sandwiches mold fluoride [vinyl] film etc. through the insulating sealing agents 5, such as EVA. In addition, 7 and 8 are the ejection lines for power ejection.

[0019] Since the substrate with the translucency electric conduction film with which the translucency electric conduction film which consists of tin oxide which makes either of the fields principal plane bearing was formed was used according to the solar battery of this this invention (301) (211), not using tempered glass, ** can also offer the solar battery for power of low cost with high reinforcement like before.

(Example) Next, the example of this invention is explained.

[0020] First, the glass which is not strengthened [3mm in thickness which formed oxidation silicon with a thickness of 1000Å as a front face, and / of dimension 350mmx450mm] was prepared, and the tin oxide film with a thickness of about 6000Å was formed with the ordinary pressure heat CVD method on oxidation silicon. SnCl₄:2mol%, H₂O:10-mol%, the formation conditions of a tin oxide film are O₂:1-mol% and CF₃CH₂F:1-mol%, and material gas changes substrate temperature with 450,500,550,600 degrees C, and forms them.

[0021] In addition, although the irregularity whose difference of elevation is about several 1000Å on the surface of a tin oxide film is formed on such formation conditions, distance between the part of a concavo-convex bottom and a substrate front face is made into thickness here.

[0022] The measured measurement result according field bearing of the tin oxide film formed in drawing 2 as mentioned above to an X diffraction is shown. In addition, as for this drawing (A), when substrate temperature is 450 degrees C, in the case of 500 degrees C, (C) shows the case of 550 degrees C and, as for (B), (D) shows the case of 600 degrees C, respectively.

[0023] Clearly from drawing 1 , to the field serving as principal plane bearing where peak intensity is the largest, when substrate temperature is 450 degrees C (this drawing (A)) and 500 degrees C (this drawing (B)) (110) (200), when substrate temperature is 550 degrees C (this drawing (C)) and 600 degrees C (this drawing (D)) (211) (301), the field serves as principal plane bearing.

[0024] In addition, in this invention, principal plane bearing shows field bearing which shows the largest peak intensity in the measurement result by the X diffraction, as stated here.

[0025] Subsequently, it prepared at a time ten glass substrates with which four kinds of these tin oxide films were formed, respectively, and reinforcement was investigated with the simple test method of a hailstorm trial. This result is shown in Table 1.

[0026] in addition, this test method -- the approach of the convention to JIS R 3212 -- it is -- concrete -- a glass side -- as facing up -- level -- fixing -- and the core of this glass -- about [mass / of 227**2g /, and diameter] -- it is the approach of dropping a shot with about 38mm smooth front face, without applying the force from height of 1m, and investigating reinforcement. And although there was no breakage of glass by this trial, it is shown in Table 1, using a rate as a yield.

[0027]

[Table 1]

主観面方位		(110)	(200)	(211)	(301)
歩留	ハターニ ンク前	30%	100%	100%	100%
	ハターニ ンク後	0%	30%	100%	100%

[0028] It turns out that it has reinforcement with the expensive substrate equipped with the tin oxide film which makes either a field (200), a field (211) or (301) a field principal plane bearing clearly from this table.

[0029] By the way, in considering as a solar battery by using as a substrate the glass with which the tin oxide film was formed in this way, it is necessary to use the laser patterning method beforehand before the photo-electric-conversion stratification which consists of an amorphous semiconductor, to remove the predetermined section of a tin oxide film, and to separate a tin oxide film for every solar battery element. And since the reinforcement of a substrate may have changed with these laser patterning, reinforcement was investigated by the same approach as the above also about the substrate after laser PATANIGU. This result is also shown according to Table 1.

[0030] In addition, it presupposed that it is the same as that of the conditions when manufacturing the solar battery of the usual accumulation mold as conditions for laser patterning, and the field of 150 micrometers of **** is removed in the shape of Rhine at intervals of about 1cm using an YAG laser with a wavelength of 1.06 micrometers.

[0031] After performing laser patterning in this way clearly from Table 1, reinforcement has deteriorated in the substrate with which the tin oxide film formed at the substrate temperature of 500 degrees C, i.e., the tin oxide film from which principal plane bearing serves as a field (200), was formed. On the other hand, substrate temperature was formed at 550 degrees C and 600 degrees C, namely, in the substrate in which the tin oxide film at least whose principal plane direction (211) (301) is a field was formed, after laser patterning, a yield is 100% and has sufficient reinforcement.

[0032] Therefore, a solar battery with high enough reinforcement can be offered by forming the tin oxide film this (211) field or (301) field of whose is principal plane bearing, or the photo-electric-conversion layer which consists of an amorphous semiconductor on this translucency electric conduction film using the substrate with which the translucency electric conduction film with which it becomes was formed.

[0033] In addition, about the reason reinforcement falls by laser patterning as mentioned above, the thing resulting from the thermal effect a tin oxide film is influenced changing is conjectured by difference of field bearing by laser radiation.

[0034] Next, in the white sheet glass with which the tin oxide film which makes a field (211) principal plane bearing bearing was formed, the result of having measured the reinforcement when changing the thickness of a tin oxide film with 5000A, 6000A, 7000A, and 8000A, respectively like the above is shown in Table 2. In addition, the trial is following the thing after laser patterning.

[0035]

[Table 2]

膜厚 (Å)	5000	6000	7000	8000
歩留	100%	100%	50%	30%

[0036] It can have reinforcement sufficient by making thickness of a tin oxide film into 6000A or less clearly from Table 2. It is guessed that this reason is a thing resulting from the time amount which laser patterning takes becoming long, and the thermal effect which glass receives becoming large; so that thickness becomes thick.

[0037] In addition, since a photoelectromotive-force property falls when it became 2000A or less practically, and a

resistance component increases and it considers as a solar battery, the thickness of a tin oxide film has 2000A or more desirable [since the time amount which laser patterning takes becomes short when the thickness of a tin oxide film is 6000A or less, it is thought that reinforcement does not fall but].

[0038] Moreover, as a result of performing the same trial using the substrate equipped with the tin oxide film whose principal plane bearing is either a field (110) or (200) a field as translucency electric conduction film, even if it made thickness thin in these cases to 2000A which is a practical minimum, the yield has not improved.

[0039] Next, the production process of this invention solar battery is explained.

[0040] Drawing 3 is a sectional view according to process for explaining the production process of the solar battery used for this invention solar battery, and has given the same sign to the same part as drawing 1.

[0041] First, at the process of drawing 3 (A), with a thickness of about 6000A tin oxide film 2' is formed with an ordinary pressure heat CVD method on this substrate 1, using the thing in which oxidation silicon with a thickness of 1000A was formed on the front face of 3mm in thickness, and dimension 350mmx450mm white sheet glass, as a substrate 1. At this time, principal plane bearing formed the tin oxide film which is a field (211) by material gas's making formation conditions O₂:1-mol% and CF₃CH₂F:1-mol% H₂O:10-mol% SnCl₄:2mol%, and making substrate temperature into 550 degrees C.

[0042] Next, at the process of this drawing (B), patterning of above-mentioned tin oxide film 2' was carried out using the YAG laser with a wavelength of 1.06 micrometers, and the translucency electric conduction film 2 for every solar battery element was formed. In addition, while carrying out patterning so that the width of face of the translucency electric conduction film 2 for every solar battery element may be set to about 1cm, respectively at this time, the resistance between the adjoining translucency electric conduction film 2 and 2 is set to 1 M omega or more by setting spacing between each translucency electric conduction film 2 to about 150 micrometers.

[0043] At the process of this drawing (C), on the translucency electric conduction film 2, subsequently, the substrate temperature of 200 degrees C, The mixed gas which consists of a mono silane, methane, and diboron hexahydride in reaction pressure 0.5 - 1.0Torr, By decomposing into this order the mixed gas which consists of a mono silane, the mixed gas which consists of hydrogen, a mono silane, a phosphine, and hydrogen within a capacity-coupling mold glow discharge cracking unit The laminating of the p mold amorphous SiC layer of about 100A of thickness, i mold amorphous silicon layer of about 4000A of thickness, and the n mold amorphous silicon layer of about 200A of thickness was carried out one by one.

[0044] And about 50 micrometers was shifted, it dissociated from the separation section of the translucency electric conduction film 2 using the 2nd higher harmonic of an YAG laser with a wavelength of 0.53 micrometers, and the layered product of the amorphous semiconductor layer of this p-i-n was used as the photo-electric-conversion layer 3 for every solar battery element.

[0045] Then, at the process shown in this drawing (D), aluminum layer with a thickness of about 250nm was formed using resistance heating vacuum deposition, about 50 more micrometers was shifted, the 2nd higher harmonic of an YAG laser with a wavelength of 0.53 micrometers separated from the leaver section of the above-mentioned photo-electric-conversion layer 3, and it considered as the rear-face electrode 4 of each solar battery element.

[0046] The amorphous solar battery of an accumulation mold is manufactured according to the above process. In addition, the above-mentioned laser scribe width of face was set to about 150 and 150 or 150 micrometers, respectively with the translucency electric conduction film, the photo-electric-conversion layer, and the rear-face electrode.

[0047] And the laminating of the rear-face protection member which is from insulating sealing agents, such as EVA, an aluminium foil sandwiches mold fluoride [vinyl] film, etc. on the rear-face electrode side of the solar battery of the accumulation mold formed by doing in this way was carried out, and the solar battery of the structure of drawing 1 was manufactured using the vacuum laminating method.

[0048] Consequently, also in the solar battery of this configuration, since the substrate with the translucency electric conduction film with which the translucency electric conduction film which consists of tin oxide whose principal plane bearing is a field (211) as a substrate was formed was used, the solar battery which has sufficient reinforcement can be offered, and a solar battery with high reinforcement can be offered by low cost, without using tempered glass like before.

[0049] Moreover, although the tin oxide whose principal plane bearing is a field (211) was used in this example, the same effectiveness is acquired even if it uses the tin oxide film whose principal plane bearing is a field (301).

[0050]

[Effect of the Invention] The solar battery which has reinforcement sufficient by low cost can be offered without using tempered glass like before by being able to offer the substrate for solar batteries with high reinforcement, and using this substrate further according to the substrate with the translucency electric conduction film equipped with the

translucency electric conduction film with which principal plane bearing by this invention consists of tin oxide which is a field (211) or (301) a field, as explained above.

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DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]

[Drawing 1] It is the sectional view of this invention solar battery.

[Drawing 2] It is as a result of [by the X diffraction of a tin oxide film] measurement.

[Drawing 3] It is a structure section Fig. classified by process for explaining the production process of the solar battery of this invention.

[Drawing 4] It is the component structure section Fig. of the conventional amorphous solar battery.

[Drawing 5] It is the sectional view of the solar battery of a super straight method.

[Description of Notations]

1 [-- A rear-face electrode, 5 / -- A sealing agent, 6 / -- A rear-face protection member, 10 / -- An optoelectric transducer, 100 / -- A unit solar battery, 110 / -- Copper foil, 120 / -- Tempered glass, 130 / -- A rear-face protection member, 140 / -- Sealing agent] -- A substrate, 2 -- The translucency electric conduction film, 3 -- A photo-electric-conversion layer, 4

[Translation done.]